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Weir Irrigation in the Upper Mun River Basin: A Field Trip in March 1998 with Some Preliminary Discussions

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Introduction

Chumphon Naewchampa [1996] studied the impacts of railway construction¹⁾ on the local economy of the upper Mae Nam Mun²⁾ basin during the first few decades of the 20th century. These impacts include the commercialization of rice production, which brought about an expansion of paddy acreage with small-scale irrigation systems.

The systems consisted of an earthen weir (*tham nop*) across a river, and channels to lead water from it to paddy fields. They were constructed on the tributaries of Mae Nam Mun and varied greatly in size: small ones were managed by only a few families, while the largest one irrigated 13,000 *rai*.³⁾ It appears, however, that the average weir irrigated 2,000 to 3,000 *rai*. Some weirs were easily destroyed by strong

currents near the end of the rainy season and needed frequent repair. In 1920, there were as many as 503 weirs in Changwat Nakhon Ratchasima⁴⁾ alone, and a further 101 and 103 in Buriram and Chaiyaphum, respectively [KS.1/1967]. Construction of these systems, especially the large ones, was encouraged by the government with some budget allocation [KS.13/743], while some farmers employed Chinese labor to do the job. Those who paid money for construction charged water fees [KS.1/1967]. Conflict over water distribution between upstream and downstream villages was not uncommon [KS.1.2/83]. Interestingly, weirs were prohibited along Lam Ta Khong, which supplied domestic water to the city of Nakhon Ratchasima, and farmers resorted to the water wheel instead [KS.13/743].

Rice acreage also increased dramatically: in the Nakhon Ratchasima region, for instance, from 73,841 *rai* in 1882 to 534,934 *rai* in 1912. The annual increment in terms of area for which the land reclamation permits were issued in the same region was 930, 2,094, and 5,123 *rai* in 1910, 1911, and 1912, respectively [*ibid.*].

These findings attracted Fukui's attention because irrigation appears to have been a norm of rice cultivation at least in the Mae Nam Mun basin in the early 20th century. This is quite contrary to what is generally accepted: that

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1) The first long-distance railway in Thailand was that between Bangkok and Nakhon Ratchasima completed in 1900. It was subsequently extended eastward to Buriram in 1925, Surin in 1926, Si Sa Ket in 1928, and finally reached the terminal of Ubon Ratchathani in 1930. Northward, Non Wat (present Non Sung) was reached in 1919, Bua Yai in 1931, and Khon Kaen in 1933.

2) Rivers and streams are called *mae nam*, *lam*, *huai* (becoming smaller in this order) in Northeast Thailand.

3) 1 *rai* = 0.16 hectare; 1 hectare = 6.25 *rai*.

4) *Changwat* and *amphoe* are the units of administration. They are often translated into "province" and "district," respectively.

most rice cultivation in Northeast Thailand was, and is, rain-fed.

Chumphon based his study on various official administration reports (*jotmai het*). Unfortunately, these documents in most cases do not mention locations of particular irrigation systems. The field trips reported here were made to these a few known localities by Chumphon and Fukui on three days in March 1998. The upper Mae Nam Mun area suffered from an unprecedented drought in 1997, and total failure of the rice crop was not uncommon. The level of water we observed during this trip, therefore, was unusually low.

I Records of the Field Trip

Location 1. Ban Kahae, Amphoe Non Thai (Called A. Non Lao in 1919), Changwat Nakhon Ratchasima (Visited on 14 March 1998)

The description of a weir near this village appears in a document of 1919 [KS.13/1476]. The weir was on Huai Ta Odd, a distributary of Lam Choeng Krai, and irrigated 3,000 *rai* covering 17 villages. It was 18 m thick, and its top was 1 m higher than the bank.

Presently a concrete weir stands about 10 m wide and 6 m high with two escape gates, replacing an earlier weir that was built 50 years ago (in 1947). Villagers know nothing about any weir older than that. For about 150 m upstream of the present weir, both banks are raised about 3 m with earth dug from the river bed. Several small outlets run through the raised banks, mainly to the right bank, consisting of a concrete flume of 50 cm width or pipes of ca. 20 cm diameter. About 300 m upstream, there is a straight canal ca. 5 m wide of apparently recent construction branching off the river to the right without a regulatory gate. About 200 m further upstream, a river as large as Huai Ta Odd itself branches off to the left, and less

than 50 m downstream of the branch there is another concrete weir. Further along the same river is a series of weirs, some of them made of earth.

The old earthen weir of 1947 was constructed as follows. Numerous short logs of ca. 5 cm diameter were buried in the river bed to make a firm bed, then long wooden pilings were driven into the bed in three or four rows across the river. The pilings were fixed by thick planks across the river and beams along the river, and the whole structure was buttressed by angled props. The wooden framework thus made was filled with earth.

The present weir supplies water to about one half of the paddy acreage of the two villages. In the past, the river carried more water and the weir was more effective than it is at present. Today, the water level is very low during the dry season, and water is too salty even for cattle.

Location 2. Huai Kong Kaeng in Amphoe Non Thai (Formerly A. Non Lao), Changwat Nakhon Ratchasima (Visited on 14 March 1998)

It is documented that a weir on Huai Kong Kaeng irrigated 800 *rai* [KS.1/1967]. A river of ca. 10 m in width with the same name flows from west to east a few hundred meters south of the *amphoe* town of Non Thai. From a bridge on the Nakhon Ratchasima — Nong Bua Khok road, a modern weir is visible to the east on this river. Concrete-lined channels branch off from the weir. Another river of similar size flows from the west to the *amphoe* town, running parallel to Huai Kong Kaeng. These two rivers originate from one river.

Location 3. Ban Sema Yai, Amphoe Bua Yai, Changwat Nakhon Ratchasima (Visited on 15 March 1998)

The largest system so far known irrigated

13,000 *rai*, and it was along Lam Sa Thaet in A. Bua Yai [*ibid.*], but its exact location is not given in the document. We visited a village with a modern weir on Lam Huai Yang, ca. 7 km south of the *amphoe* town. Constructed by the Royal Irrigation Department (RID) in 1987, this weir replaced an earthen weir at the same site. The old weir was destroyed by high flow in the late rainy season nearly every year and had to be rebuilt each time. The repair work took villagers 2-3 days.

According to the former village headman, the old and new weirs similarly have supplied domestic water in the dry months but have never been used for rice-growing. The same can be said about other weirs in the vicinity. Ever increasing salinity during the driest months has made the water unsuitable for cattle in recent years.

Rice was not sold before the railway was built. After the railway opened, rice for sale was carried by ox-cart to the station at either Non Thong Lang or Bua Yai. Non-glutinous as well as glutinous rice was cultivated then and now, and both types were sold.

Location 4. Ban Talat Nong Du, Amphoe Nong Daeng, Changwat Nakhon Ratchasima (Visited on 15 March 1998)

This village lies along Lam Sa Thaet. In the past it belonged to A. Bua Yai, later was transferred to A. Prathai. Presently it is part of the newly created A. Nong Daeng. The largest system covering 13,000 *rai* reported in the document above might well have been in the vicinity of this village.

According to villagers, the area along Lam Sa Thaet was grassy, swampy land until the early 1950s, when RID started to construct a network of canals. In those days, villagers took a boat or waded water to the town of Phimai. The sudden rise and fall of the water level prevented agri-

cultural landuse. Before completion of the RID's work, there were many earthen weirs on Lam Sa Thaet. These weirs were not equipped with channels; the dammed-up river water simply overflowed the banks into the paddy fields.

RID constructed a modern weir on Mae Nam Mun just downstream of Phimai, from where a main canal, Khlong 6 Yaek Sai, branches off to the northeast. Lam Sa Thaet flows roughly parallel with it about 10 km to the north. Six parallel lateral canals about 2-3 km apart connect Khlong 6 Yaek Sai and Lam Sa Thaet, through which water flows from the former to the latter. The stretch of Lam Sa Thaet where the connecting canals meet it has been straightened, while upstream and downstream remains meandering. Lam Sa Thaet joins Mae Nam Mun about 30 km downstream.

On the meandering stretches of Lam Sa Thaet, there still are old earthen weirs. We saw one of them a few kilometers upstream of the confluence of the first (westernmost) connecting canal. The weir has an escape channel immediately upstream of the weir to the left side, which is as wide as Lam Sa Thaet itself.

Location 5. Ban Khuan Yai, Amphoe Dan Khun Thot, Changwat Nakhon Ratchasima (Visited on 16 March 1998)

According to [KS.13/743], the water supply from weirs was so plentiful in A. Phanchana (A. Dan Khun Thot) in 1912 that few fields were dependent totally on rain.

About 10 km east of the *amphoe* town, there is a large modern reservoir on Lam Choeng Krai, which was constructed by RID in 1970. Lam Choeng Krai is dammed up by a dike over 3 km long with a sluice gate in the middle, and two smaller gates leading to irrigation canals. The village we visited is a few kilometers upstream (west) of the reservoir, and its paddy fields are not benefited by it.

There are two earthen weirs remaining in the village, both over 100 years old. In the past, neighboring villages also had one or two similar weirs. All of them are on Lam Choeng Krai. One of the remaining weirs we observed is about 15 m wide and 3 m high. Part of the row of old pilings supporting the weir can be seen. Bamboo protect the weir. About 15 m upstream of the weir, there is an escape channel on the left, which is as wide as Lam Choeng Krai itself. It rejoins the river some distance downstream. At the divergence of the escape channel, there is an earthen dike of similar construction to but slightly lower than the weir. Two irrigation ditches run from the weir, one on the left and the other on the right, but they have been out of use for quite some time, because of insufficient flow of water. In the past, they supplied water to paddy fields in the early rainy season, from the time of plowing or transplanting depending on the year. When still in use, the weirs were damaged by high water nearly every year and had to be repaired in December or January.

II Discussions

Geography of the Upper Mae Nam Mun Basin

The whole of Northeast Thailand or the Khorat Plateau is a Mesozoic-Early Tertiary basin. Since the uplift about 12 million years ago, it has been an erosional surface subject to simultaneous actions of deep weathering and surface washout (called double planation or etchplanation by Büdel [1982]). Apart from the outer rim ranges, and the Phu Phan range in the middle of the plateau, it is a vast plane with gentle undulation at the altitude from ca. 250 m in the northwest to ca. 150 m in the southeast. A large part of the low-relief plane, especially in the upper Mae Nam Mun basin, is underlain by the salt-bearing Maha Sarakham Formation of the Early Tertiary. Where salt occurs in the weath-

ering crust of this formation, it may be carried upward to the surface by capillary action causing saline soil and water.

Looking closer at the plane, several planes can be recognized at differing levels (less than 50 m in relative altitude) with different surface configurations, profiles, and soils. The lowest are extensive depressions covered with thin alluvium. In the upper Mae Nam Mun basin, the lowest plane is Thung Samrit,⁵⁾ through which Mae Nam Mun flows from west to east. Since Thung Samrit is located at the southwest corner of the Khorat Plateau, the tributaries of Mae Nam Mun drain there from all directions except the east. Surrounding Thung Samrit is a roughly concentric series of planes, which rise in steps toward the outer rim ranges. The second lowest plane, one to a few meters above the lowest, immediately surrounds Thung Samrit to the west and north. Dissection of this plane by tributaries of Mae Nam Mun results in valley-like, shallow elongated depressions, quasi-valleys,⁶⁾ radiating from Thung Samrit. The weirs we observed are all but one in this type of depression.

These quasi-valleys are only a few kilometers wide and quite flat. Rivers flowing in them often branch and rejoin. There is considerable confusion about the names of these channels among local people. Some of these channels may be natural, while others are man-made. Some that villagers consider to be "natural" might actually be old man-made channels. In many cases, an earthen weir was built a short distance of a branching point, so that the free branch could serve as an escape channel, pro-

5) *Thung* means "fields," and is often used as a prefix of place name.

6) They are not "valleys" in the strict sense because the rivers do not incise the underlying bedrock but simply transport the weathered materials near to the surface.

tecting the weir: e.g., B. Kahae (Loc. 1), Huai Kong Kaeng (Loc. 2), B. Talat Nong Du (Loc. 4), and B. Khuan Yai (Loc. 5).

The catchment area of tributaries of Mae Nam Mun in its upper basin varies greatly. Some originate within a few tens of kilometers from Thung Samrit, others from the outer rim ranges over 100 km away. Lam Huai Yang extends less than 15 km upstream from B. Sema Yai (Loc. 3). Lam Choeng Krai which passes through B. Khuan Yai (Loc. 5) and B. Kahae (Loc. 1), originates from the outer rim range to the northwest, having an extensive catchment. Huai Kong Kaeng (Loc. 2) is a branch of Huai Dan which extends northwestward about 30 km upstream from A. Non Thai to Nong Bua Khok. Unlike the other tributaries, Lam Sa Thaet, along which B. Talat Dong Du (Loc. 4) is located, is a drainage channel which collects water from all rivers north of Lam Choeng Krai, including Huai Krabuang from A. Bua Yai and Huai Ban Ngieu from A. Khong, and flows to eastward in the northern Thung Samrit.

Efficacy of the Weirs

In B. Sema Yai (Loc. 3), the weir has been used only for domestic water supply. This might be due to the insufficient flow, since Lam Huai Yang has a limited catchment above this village as mentioned previously. Apart from this case, villagers unanimously affirm use of the weirs for rice-growing, particularly in the earlier stages of cultivation, at least in the past, if not at present. There is no case of double cropping of rice by this type of weir irrigation. It is always a supplementary irrigation for the rainy season rice. The documents collected by Chumphon provide evidence for the efficacy of the weirs in the past: e.g., the private investment in weir construction, the water charge, and the confrontation between upstream and downstream villages over water distribution. The

fact that most, if not all, of the weirs are still in use, regardless of whether they are earth-made or have been replaced with modern weirs of concrete, confirms their efficacy even at present.

However, it is also true that villagers are unanimous in complaining about ever decreasing water flow and increasing salinity. In B. Khuan Yai (Loc. 5), the flow became so impoverished that the old earthen weir that was formerly effective is no longer in use.

The acreage of paddy lands in the Northeast increased more than ten times during the first half of the 20th century. Since the reclamation was toward higher ground with poorer soils, the average yield of rice per unit area decreased significantly during the same period. Rice farmers always try to keep as much water as possible in their fields. The reclamation, therefore, most probably brought about hydrological, if not soil fertility, deterioration of older fields in depressions. The decreasing volume of river flow might be the result of ever expanding paddy lands rather than climate change.

Saline soils occur around the lower slopes of undulations when reclaimed for paddy lands. The shallow subsurface flow containing salt is said to surface there. This is because reclamation of paddy lands involves lowering and flattening of the ground surface. Reclamation of paddy lands proceeds from the bottom of undulations (wash depressions) toward the higher portions on both sides (wash divides). It is natural, therefore, that the reclamation results in a larger area of salinity, from where salty water flows down to older fields and channels.

Durability of the Weirs

One reason for the frequent damage suffered by earthen weirs is that they are not equipped with escape sluices. One way to make them more durable appears to be to dig an escape channel upstream of the weir, or where a river branches

off naturally, to make a weir on one branch immediately downstream of the branching point. We observed these features at B. Kahae (Loc. 1), B. Talat Nong Du (Loc. 4) and B. Khuan Yai (Loc. 5).

Water Supply from Weirs to Paddy Fields

The quasi-valleys cutting the low plane northwest of Thung Samrit slope very gently longitudinally. Where a weir is located at a drop in the river bed, the level of the dammed-up water could rise higher than the banks, allowing water to be led by gravity through channels to paddy fields. Such is the case of the modern weir at Huai Kong Kaeng (Loc. 2) and the earthen one at B. Khuan Yai (Loc. 5), though the latter is no longer in use. Where a weir is located in very flat terrain, there is no other way but to allow water simply to spill over the banks to adjacent paddy fields, which is the case at Lam Sa Thaet (Loc. 4).

Process of Paddy Land Reclamation in the Upper Mae Nam Mun Basin in the 20th Century

Today, the intact (not dissected) surface of the lower planes is also planted to rice. Since the higher parts are too sandy to retain standing water for rice, they are planted to upland crops such as cassava and sugarcane or remain as bush lands or sparse forests. The paddy fields on the intact planes are purely rain-fed, and were reclaimed only a few decades ago. The reclamation of the quasi-valleys in the upper Mae Nam Mun basin in the 1920s indicates that there were still plenty of potentially irrigable lands to be opened then.

The area along Lam Sa Thaet is the lowest in Thung Samrit. It needed a network of modern canals to distribute flood water evenly in time and space for agricultural landuse. The absence of feeder canals from the earthen weirs before the 1950s suggests that the old weirs also play-

ed the similar function, though less effectively. The situation is basically the same as the lower Chao Phraya delta. The rest of Thung Samrit is not flooded so deeply. It might have been cultivated with or without canals for a long time, perhaps since the Khmer period.

Chumphon thought that rice had been cultivated under the rain-fed conditions when it was merely for subsistence, but that weir irrigation was introduced when it came to be cultivated for commerce [Chumphon 1996]. Fukui does not agree with him, and believes that as far as the land conditions allowed, rice must have been grown with irrigation regardless of the purpose of cultivation, since the best suited lands are always chosen first, and the technology, labor organization, and capital required for the simple weir irrigation must have been available for subsistence farmers. Fukui believes that rain-fed rice had not yet been cultivated in the area under discussion in the 1920s. The prevalence of rain-fed rice today appears to be the result of (1) reclamation of the intact surface of the lower planes, and (2) the resulting hydrologic deterioration of the formerly weir-irrigated lands.

Weir Irrigation in the Rest of the Khorat Plateau

The notion that rain-fed rice is dominant in the Northeast is so strong that little care has been paid to the possibility of irrigated rice in early days. Focused studies might reveal the significance of irrigated rice elsewhere, too. At present, we can say little about its popularity over the whole Northeast. Below are some preliminary considerations.

The upper Mae Nam Mun basin has the scantiest rainfall in the whole Northeast, so that the need for irrigation might have been more keenly felt here than elsewhere. Therefore, reclamation of rain-fed paddy lands might have proceeded earlier elsewhere. Furthermore, the

tributaries flowing into Thung Samrit are blessed with rather extensive catchment areas, so that weir irrigation would have been more viable here than elsewhere.

Reclamation with weir irrigation for commercial production of rice was vigorously pursued in the area in the 1920s thanks to the railway construction, as Chumphon's study showed. Some weirs were even subsidized by local government agencies. This might be one reason why weir construction drew the attention of local administrators and was documented. Reclamation with weirs might also have occurred elsewhere, but it was not recorded because of its modest rate of progress under the subsistence economy.

Looking further into the past, ancient settlements apparently concentrate in lowlands of various landforms. Though we do not know whether any kind of irrigation existed there, it is certain that they are potentially irrigable, being quite different from the present rain-fed rice lands.

The Ban Chiang site in Changwat Udonthani and other contemporary pre-historic sites in the northern half of the Khorat Plateau lie along narrow quasi-valley depressions similar to those in the upper Mae Nam Mun basin through which rivers and streams flow. The Dvaravati and Khmer sites are apparently in more extensive depressions, probably related to local tectonic subsidence; the former in the one along Mae Nam Chi between Khon Kaen and Selaphum, and the latter in Thung Samrit. But they are not so low as to remain wet throughout the year.

Travelers of the early 20th century noted that there were many swampy pockets on the plateau, which were difficult for carts to cross, and they sometimes had to make long detours. At least until the 1960s, the Northeast was second only to the Central region in the acreage planted to broadcast rice (probably close to

floating rice). The Lao who migrated in great numbers to the Northeast from the late 18th century drained these swamps and made them into paddy lands. These swampy depressions are locally called "*nong*." The reclaimed *nong* may sometimes retain a much shrunken water body in the center [Fukui 1993: 169-170]. Some of larger *nong* remain as lakes and ponds to this day, e.g., Nong Han Kumphawapi in C. Udonthani, Nong Han Sakon Nakhon in C. Sakon Nakhon, and many lakes in the lower Mae Nam Songkhram basin. The others have been reclaimed rather recently, e.g., the area along Lam Sa Thaet mentioned above, and the whole of Thung Kula Rong Hai, a vast flat depression downstream of Thung Samrit along Mae Nam Mun.

It appears that it was only after most of these lowlands, the quasi-valleys along minor and major rivers, and the *nong*, had been reclaimed that paddy lands started to be reclaimed on the intact surfaces of the planes of different levels. Though the exact chronology of reclamation of different kinds of land has not been ascertained, and may vary from a locality to another, the case of the upper Mae Nam Mun basin calls for more attention to the possibility of early irrigation in the Khorat Plateau.

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